Cataract surgery has transitioned from a standardized, lens-based procedure to refractive surgery. This evolution has required the assembly of different parts, like a puzzle, to optimize postoperative distance and near UCVA. New phaco platforms, instruments, and IOLs, along with the new techniques and the right attitude, have enabled the pieces of this puzzle to come together. This article discusses the elements that have allowed us to improve the refractive results of cataract surgery.

SURGICAL TECHNIQUE
The adoption of microincision cataract surgery (MICS), defined as cataract surgery performed through an incision of less than 2 mm, has reduced surgically induced astigmatism.1 Although standard 3-mm phacoemulsification provides satisfactory results in terms of safety, efficiency, and refractive outcomes, studies have shown that MICS is a minimally invasive procedure with increased safety and less surgically induced astigmatism.2-4 Initially, MICS implied a bimanual approach that demanded a steep learning curve, limiting its adoption. More recently, however, some companies have modified their phaco platforms to a microcoaxial approach that requires almost no learning curve. MICS is becoming the gold standard and is now accessible to almost all surgeons.

PHACO PLATFORMS
The transition to MICS has been facilitated by the ophthalmic industry through development of sophisticated MICS phaco platforms, instruments, and implants that are compatible with MICS. Several technical points have been adjusted to optimize the results of phaco machines used in conjunction with microincisions. Smaller incision sizes require the use of a microphaco tip, and 20-gauge phaco tips can currently be used with all types of machines. The smaller internal diameter of the phaco tip reduces its holding power. However, special tip designs, such as the flared tip, counteract this limitation. Additionally, the restricted inner phaco tip diameter can slow the speed of surgery. Thus, the use of smaller phaco tips requires higher vacuum settings to perform phacoemulsification effectively.

Fluidics is regulated by peristaltic or venturi pumps. The latest pumps are computer-driven, offering the best of the two systems to equilibrate in- and outflow. The goal is to obtain a stable anterior chamber throughout the steps of phacoemulsification. Antisurge tubing and algorithms and anticlogging filters are currently available. These technological advances reduce the incidence of clogging and postocclusion surge and improve anterior chamber stability even with higher levels of vacuum.

The developments of ultrasound modulation, torsional tip oscillation, and lower-frequency phaco handpieces have limited the temperature at the incision site and decreased the amount of energy delivered into the eye. Most modern machines allow customized ratios of on- and off-time power settings (duty cycle), torsional or longitudinal oscillation ratios, and variable power intensities to minimize the total amount of phaco energy delivered to the eye. The modulation of ultrasound has transformed phacoemulsification from an ultrasound-driven technique to an aspiration and manual chopping technique. Effective fluidics control and power modulation software have contributed to the acceptance of MICS. They have also shortened the learning curve and improved the effectiveness and safety of the procedure, providing faster visual recovery for patients.5,6

INSTRUMENTS
Smaller incision sizes require surgical instruments to be perfectly calibrated. This requirement is crucial to guarantee intraoperative anterior chamber stability, integrity of incision architecture, and the self-sealing properties of the wound postoperatively. Microblades are necessary to obtain an incision size only slightly larger than the ultrasound and I/A probes. Trapezoidal blades (1.6 X 1.8 mm) allow equilibrated fluid inflow with limited friction of the probe during the various steps of surgery. This incision size is compatible with wound-assisted implantation of most MICS IOLs.

The capsulorrhexis is easily performed with a bent needle or microforceps specifically designed for sub–2-mm incisions. I/A probes with thinner sleeves are also available.
PATIENT EXPECTATIONS

As refractive phacoemulsification is adopted by an increasing number of cataract surgeons, patient expectations have also increased. For this reason, patients need detailed preoperative informed consent. The patient’s profile, profession, hobbies, and last but not least expectations must be thoroughly considered and should influence final surgical decisions.

PREOPERATIVE ASTIGMATIC EVALUATION

Preoperative evaluation of corneal astigmatism is necessary for surgical correction during surgery and to guarantee a satisfactory postoperative UCVA. Ideally, postoperative corneal astigmatism should be no more than 0.50 D to optimize UCVA. In cataract patients, preoperative corneal astigmatism is negligible in 60% of patients. In these cases, surgery performed through an astigmatically neutral incision may maximize the chances of excellent postoperative UCVA. Greater degrees of corneal astigmatism may require specific surgical management. In patients with mild astigmatism, a larger incision properly aligned on the steep axis may be sufficient to reduce the postoperative cylinder. In patients with moderate and high astigmatism, incisional techniques or toric IOLs have been shown to be effective.

Incision size and location may affect postoperative astigmatism. Temporal, micro, or standard incisions can be used to minimize postoperative astigmatism in patients with negligible, mild, or against-the-rule astigmatism. A superior approach is preferable in eyes with preoperative with-the-rule astigmatism.

IOL OPTIONS

The IOLs currently on the market provide a wide range of refractive options. Patient and surgeon must work together to choose the appropriate lens to achieve a satisfactory refractive result. Standard monofocal lenses have been widely used with excellent results. Over the past decade, multifocal, toric, and accommodating IOLs have been shown to be effective and provide better UCVA at various distances, with a high rate of spectacle independence.

More recently, an increasing number of MICS IOLs, which are thinner than standard lenses, have been proposed. They are easily implantable through sub-2-mm incisions with a wound-assisted technique. Specific cartridge and syringe-type injectors ensure safe and reproducible implantation with no need for incision enlargement. Studies have shown that MICS IOLs provide excellent optical performance and stable refractive results. Some of the lenses have multifocal optics and can also correct astigmatism.

CONCLUSION

During the first decade of the new millennium, we have witnessed a significant reduction in incision sizes and the development of MICS. The industry has optimized MICS platforms, instruments, and IOLs. Additionally, IOL technology has evolved with the onset of premium lenses dedicated to correcting presbyopia and astigmatism. The premium lens market is constantly evolving to optimize refractive results with limited side effects and improve UCVA at all distances. Today, we can propose to our patients the restoration of accommodation mainly with pseudoaccommodating lenses. In the second decade of the millennium, as technology continues to improve, true accommodating IOLs may arrive and fulfill our desire to restore optimal UCVA at all distances.

Jean-Luc Febbraro, MD, is an Attending Surgeon at the Rothschild Foundation of Paris. Dr. Febbraro states that he received travel support from Alcon Laboratories, Inc., and Bausch + Lomb in 2010. He may be reached at tel: +33 1 53 65 19 65; e-mail: jeanluc@febbraro.net.